PATENT COOPERATION TREA[illegible]

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

United States Patent and Trademark Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 02 February 1999 (02.02.99)	
International application No. PCT/NO98/00182	**Applicant's or agent's file reference** INT98077D
International filing date (day/month/year) 12 June 1998 (12.06.98)	**Priority date** (day/month/year) 16 June 1997 (16.06.97)
Applicant TSCHUDI, Jon	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

21 December 1998 (21.12.98)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Eugénia Santos

Telephone No.: (41-22) 338.83.38

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 98/00182

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G06K 9/00, A61B 5/117
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G01B, G06K, A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0735502 A2 (TRW INC), 2 October 1996 (02.10.96), see the whole document	1-3,6-7,9,14
A	--	4-5,8,10-13, 15-16
X	JP 8154921 A ((NITE) NIPPON TELEGRAPH & TELEPHONE CORP), 18 June 1996 (18.06.96)	1,6,15
A	--	2-5,7-14,16
PX	JP 10003532 A ((SONY) SONY CORP), 6 January 1998 (06.01.98)	1,6
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 November 1998	27 -11- 1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Pernilla Hall Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 98/00182

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	JP 10222641 A ((NIDE) NEC CORP), 21 August 1998 (21.08.98) --	1,6
A	WO 8606266 A1 (JYDSK TELEFON A/S), 6 November 1986 (06.11.86), see the whole document --	1-16

INTERNATIONAL SEARCH REPORT

Information on patent family members

03/11/98

International application No.
PCT/NO 98/00182

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0735502 A2	02/10/96	CN 1136189 A	20/11/96
		JP 8287240 A	01/11/96
JP 8154921 A	18/06/96	NONE	
JP 10003532 A	06/01/98	NONE	
JP 10222641 A	21/08/98	NONE	
WO 8606266 A1	06/11/86	AU 5817286 A	18/11/86
		DK 155242 B,C	13/03/89
		DK 198485 A	03/11/86
		EP 0220294 A,B	06/05/87
		SE 0220294 T3	
		US 4784484 A	15/11/88

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

ABC-PATENT, SIVILING. ROLF CHR. B.
LARSEN A.S
Brynsveien 5
N-0667 Oslo
NORVEGE

07 AUG 1998

Date of mailing (day/month/year) 28 July 1998 (28.07.98)	
Applicant's or agent's file reference INT98077D	**IMPORTANT NOTIFICATION**
International application No. PCT/NO98/00182	International filing date (day/month/year) 12 June 1998 (12.06.98)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 16 June 1997 (16.06.97)
Applicant SINTEF et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.

3. An **asterisk(*)** appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

4. The **letters "NR"** appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
16 June 1997 (16.06.97)	972759	NO	24 July 1998 (24.07.98)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

A. Karkachi

Telephone No. (41-22) 338.83.38

002154321

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
ABC-PATENT, SIVILING. ROLF CHR. B. LARSEN A.S
Brynsveien 5
N-0667 Oslo
NORVÈGE

MOTTATT/RECEIVED
4 JAN 1998
ABC-Patent
Siviling. Rolf Chr. B. Larsen a.s

Date of mailing (day/month/year)	
23 December 1998 (23.12.98)	
Applicant's or agent's file reference	**IMPORTANT NOTICE**
INT98077D	

International application No.	International filing date (day/month/year)	Priority date (day/month/year)
PCT/NO98/00182	12 June 1998 (12.06.98)	16 June 1997 (16.06.97)

Applicant
SINTEF et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,BR,CA,CN,EP,IL,JP,KP,KR,PL,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AL,AM,AP,AT,AZ,BA,BB,BG,BY,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GE,GH,GM,GW,HU,ID,IS,KE,
   KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PT,RO,RU,SD,SE,SG,SI,SK,SL,
   TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   23 December 1998 (23.12.98) under No. WO 98/58342

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer
J. Zahra

Telephone No. (41-22) 338.83.38

Continuation of Form PCT/IB/3

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

Date of mailing (day/month/year)	IMPORTANT NOTICE
23 December 1998 (23.12.98)	
Applicant's or agent's file reference	**International application No.**
INT98077D	PCT/NO98/00182

The applicant is hereby notified that, at the time of establishment of this Notice, the time limit under Rule 46.1 for making amendments under Article 19 has not yet expired and the International Bureau had received neither such amendments nor a declaration that the applicant does not wish to make amendments.

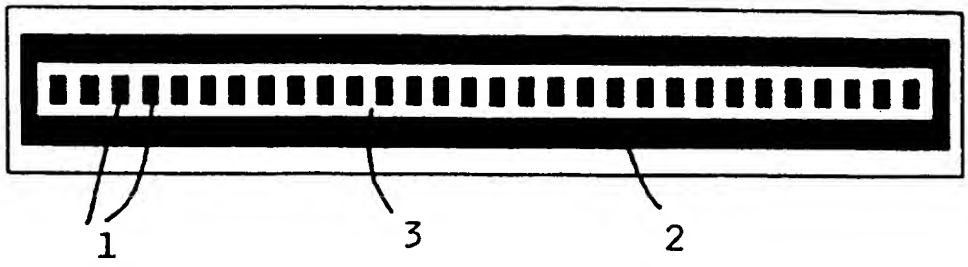

FIG. 1A

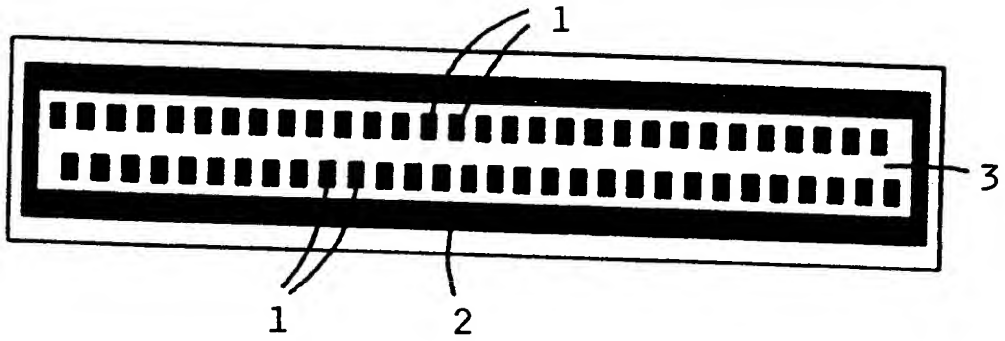

FIG.1B

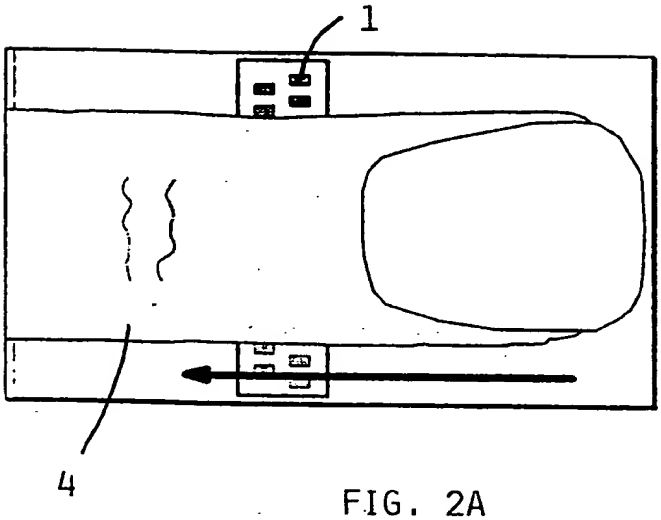

FIG. 2A

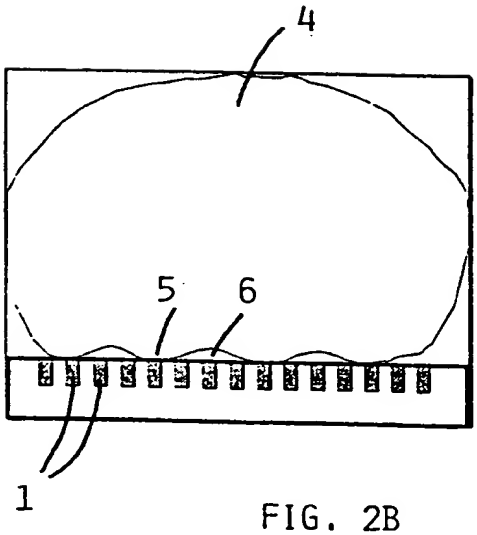

FIG. 2B

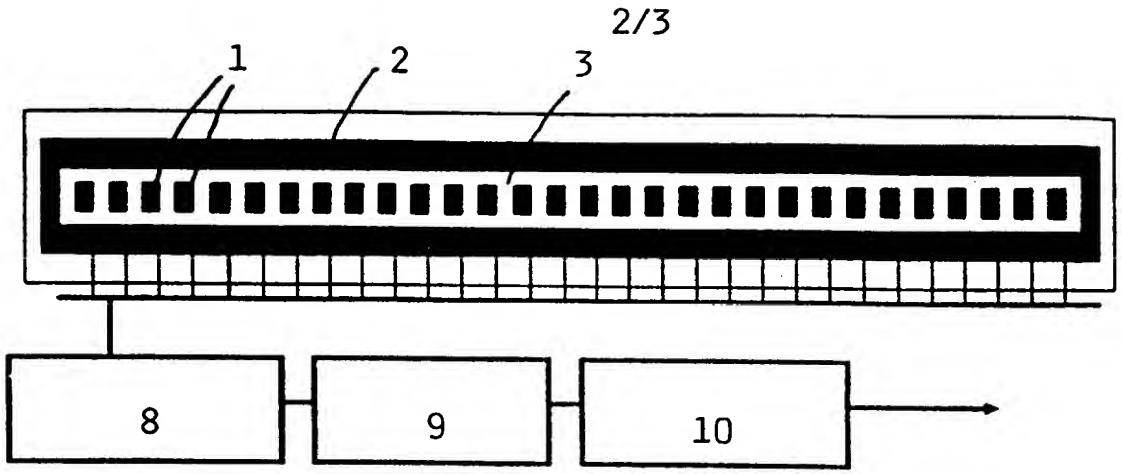

FIG. 3

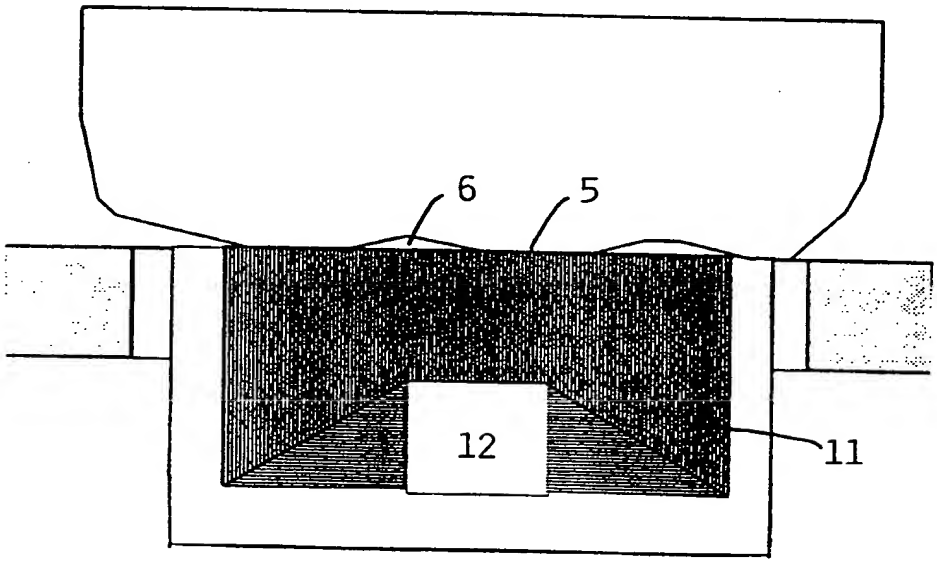

FIG. 4

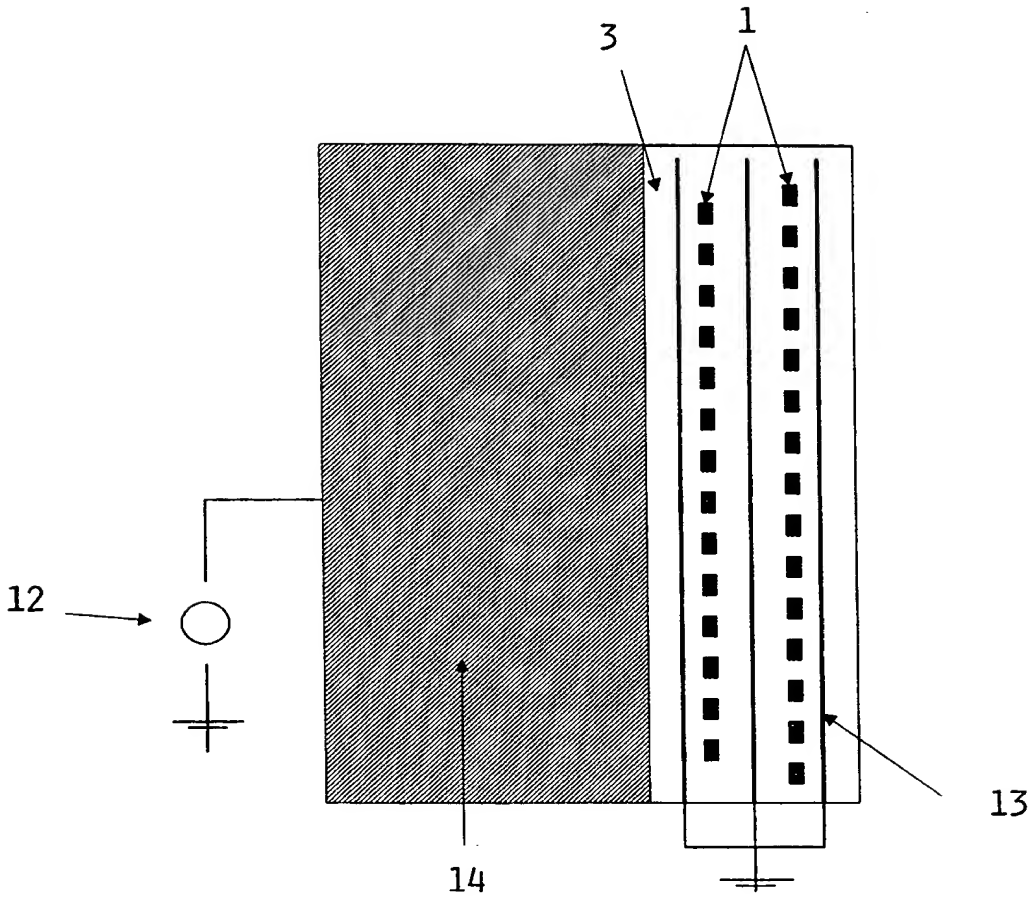

FIG.5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 98/00182

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G06K 9/00, A61B 5/117
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G01B, G06K, A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0735502 A2 (TRW INC), 2 October 1996 (02.10.96), see the whole document	1-3,6-7,9,14
A		4-5,8,10-13, 15-16
	--	
X	JP 8154921 A ((NITE) NIPPON TELEGRAPH & TELEPHONE CORP), 18 June 1996 (18.06.96)	1,6,15
A		2-5,7-14,16
	--	
PX	JP 10003532 A ((SONY) SONY CORP), 6 January 1998 (06.01.98)	1,6
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 November 1998	27 -11- 1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Pernilla Hall Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 98/00182

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	JP 10222641 A ((NIDE) NEC CORP), 21 August 1998 (21.08.98)	1,6
	--	
A	WO 8606266 A1 (JYDSK TELEFON A/S), 6 November 1986 (06.11.86), see the whole document	1-16
	--	

INTERNATIONAL SEARCH REPORT

Information on patent family members

03/11/98

International application No.
PCT/NO 98/00182

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0735502 A2	02/10/96	CN 1136189 A	20/11/96
		JP 8287240 A	01/11/96
JP 8154921 A	18/06/96	NONE	
JP 10003532 A	06/01/98	NONE	
JP 10222641 A	21/08/98	NONE	
WO 8606266 A1	06/11/86	AU 5817286 A	18/11/86
		DK 155242 B,C	13/03/89
		DK 198485 A	03/11/86
		EP 0220294 A,B	06/05/87
		SE 0220294 T3	
		US 4784484 A	15/11/88

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For Receiving Office use only

International Application No. PCT/NO 98/ 00182

International Filing Date 12 JUNI 1998 (12.06.98)

Patentstyret

STYRET FOR DET INDUSTRIELLE RETTSVERN
PCT INTERNATIONAL APPLICATION
Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* INT98077D

Box No. I TITLE OF INVENTION

METHOD AND APPARATUS FOR MEASURING OF STRUCTURES IN A SURFACE

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

SINTEF
Strindveien 2
N-7034 TRONDHEIM
Norway

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(i.e. country)* of nationality: NO

State *(i.e. country)* of residence: NO

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

TSCHUDI, Jon
Brinken 16B
N-0654 OSLO
Norway

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: NO

State *(i.e. country)* of residence: NO

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

ABC-Patent,
Siviling. Rolf Chr. B. Larsen a.s
Brynsveien 5
N-0667 OSLO
Norway

Telephone No. 22 07 19 50

Facsimile No 22 07 19 55

Teleprinter No

☐ Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- ☒ AP **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- ☒ AL Albania .....
- ☒ AM Armenia .....
- ☒ AT Austria .....
- ☒ AU Australia .....
- ☒ AZ Azerbaijan
- ☒ BA Bosnia and Herzegovina .....
- ☒ BB Barbados
- ☒ BG Bulgaria .....
- ☒ BR Brazil .....
- ☒ BY Belarus
- ☒ CA Canada
- ☒ CH and LI Switzerland and Liechtenstein
- ☒ CN China .....
- ☒ CU Cuba .....
- ☒ CZ Czech Republic .....
- ☒ DE Germany .....
- ☒ DK Denmark .....
- ☒ EE Estonia .....
- ☒ ES Spain .....
- ☒ FI Finland .....
- ☒ GB United Kingdom
- ☒ GE Georgia .....
- ☒ GH Ghana .....
- ☒ GM Gambia
- ☒ GW Guinea-Bissau .....
- ☒ HU Hungary .....
- ☒ ID Indonesia
- ☒ IL Israel .....
- ☒ IS Iceland
- ☒ JP Japan .....
- ☒ KE Kenya .....
- ☒ KG Kyrgyzstan .....
- ☒ KP Democratic People's Republic of Korea .....
- ☒ KR Republic of Korea .....
- ☒ KZ Kazakhstan .....
- ☒ LC Saint Lucia
- ☒ LK Sri Lanka
- ☒ LR Liberia
- ☒ LS Lesotho .....
- ☒ LT Lithuania
- ☒ LU Luxembourg
- ☒ LV Latvia
- ☒ MD Republic of Moldova .....
- ☒ MG Madagascar .....
- ☒ MK The former Yugoslav Republic of Macedonia .....
- ☒ MN Mongolia
- ☒ MW Malawi .....
- ☒ MX Mexico .....
- ☒ NO Norway
- ☒ NZ New Zealand .....
- ☒ PL Poland .....
- ☒ PT Portugal .....
- ☒ RO Romania
- ☒ RU Russian Federation .....
- ☒ SD Sudan
- ☒ SE Sweden
- ☒ SG Singapore
- ☒ SI Slovenia .....
- ☒ SK Slovakia .....
- ☒ SL Sierra Leone
- ☒ TJ Tajikistan .....
- ☒ TM Turkmenistan .....
- ☒ TR Turkey .....
- ☒ TT Trinidad and Tobago .....
- ☒ UA Ukraine .....
- ☒ UG Uganda .....
- ☒ US United States of America .....
- ☒ UZ Uzbekistan .....
- ☒ VN Viet Nam .....
- ☒ YU Yugoslavia .....
- ☒ ZW Zimbabwe .....

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- ☐ .....
- ☐ .....
- ☐ .....

In addition to the designations made above, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except the designation(s) of _____.

The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM Further priority claims are indicated in the Supplemental Box ☐

The priority of the following earlier application(s) is hereby claimed:

Country (in which, or for which, the application was filed)	Filing Date (day/month/year)	Application No.	Office of filing (only for regional or international application)
item (1) NO	16.06.97 (16 June 1997)	97.2759	
item (2)			
item (3)			

Mark the following check-box if the certified copy of the earlier application is to be issued by the Office which for the purposes of the present international application is the receiving Office (a fee may be required):

☒ The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s): 1

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):* ISA / SE

Earlier search *Fill in where a search (international, international-type or other) by the International Searching Authority has already been carried out or requested and the Authority is now requested to base the international search, to the extent possible, on the results of that earlier search. Identify such search or request either by reference to the relevant application (or the translation thereof) or by reference to the search request:*

Country (or regional Office): Date *(day/month/year)*: Number:

Box No. VIII CHECK LIST

This international application contains the following number of sheets:

1. request	:	3 sheets
2. description	:	7 sheets
3. claims	:	4 sheets
4. abstract	:	1 sheets
5. drawings	:	3 sheets
Total	:	18 sheets

This international application is accompanied by the item(s) marked below:

1. ☐ separate signed power of attorney
2. ☐ copy of general power of attorney
3. ☐ statement explaining lack of signature
4. ☐ priority document(s) *identified in Box No. VI as item(s):*
5. ☒ fee calculation sheet
6. ☐ separate indications concerning deposited microorganisms
7. ☐ nucleotide and/or amino acid sequence listing (diskette)
8. ☒ other *(specify)*: Official letter dated 31.10.97

Figure No. 2A of the drawings (if any) should accompany the abstract when it is published.

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Oslo, 12. juni 1998

ABC-Patent,
Siviling. Rolf Chr. B. Larsen a.s

For receiving Office use only

1. Date of actual receipt of the purported international application: 12 JUNI 1998 (12.06.98)
2. Drawings: ☒ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority specified by the applicant: ISA / SE
6. ☐ Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

This sheet is not part of and does not count as a sheet of the international application.

PCT

FEE CALCULATION SHEET
Annex to the Request

For receiving Office use only

PCT/NO 98/00182
International application No.

12 JUNI 1998 (12.06.98)
Date stamp of the receiving Office

Applicant's or agent's file reference: INT98077D

Applicant: SINTEF

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE . . . . . 500,- T

2. SEARCH FEE . . . . . 5.750,- S

International search to be carried out by _____
(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

12.jun98 635811 PCT 98/00182 19 17.520,00

Basic Fee 12.jun98 635812 PCT 98/00182 89 500,00

The international application contains 18 sheets. 12.jun98 635813 PCT 98/00182 87 300,00

first 30 sheets . . . . . 3.300,- b_1

_____ x _____ = _____ b_2
remaining sheets additional amount

Add amounts entered at b_1 and b_2 and enter total at B . . . . 3.300,- B

Designation Fees
The international application contains all designations.

11 x 770 = 8.470,- D
number of designation fees payable *(maximum 11)* amount of designation fee

Add amounts entered at B and D and enter total at I . . . . . 11.770,- I

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

4. FEE FOR PRIORITY DOCUMENT . . . . . 300,- P

5. TOTAL FEES PAYABLE
Add amounts entered at T, S, I and P, and enter total in the TOTAL box . . 18.320,- TOTAL

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☐ authorization to charge deposit account (see below)	☐ bank draft	☐ coupons
☒ cheque	☐ cash	☐ other *(specify):*
☐ postal money order	☐ revenue stamps	

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☐ is hereby authorized to charge the total fees indicated above to my deposit account.

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See Notes to the fee calculation sheet

METHOD AND APPARATUS FOR MEASURING STRUCTURES IN A FINGERPRINT

The invention relates to a method and an apparatus for the measuring of structures in a fingerprint or the like, comprising the measuring of chosen characteristics of the surface of the fingerprint, e.g. capacitance or resistivity, using a sensor array comprising a plurality of sensors, positioned in contact with, or close to, the surface.

Identification by the use of fingerprints has lately come to the fore as a result of the increasing needs for security relating to, for example, credit cards or computer systems as well as the greatly increased availability of pattern recognition algorithms. Some systems for recognition of fingerprints have already been made available on the market. The techniques used to register the fingerprint varies.

Some of the previously known solutions are based upon optical technology using light with one or more wavelengths. These are sensitive to dirt and contamination, both in the fingerprint and on the sensor surface, and thus cleaning is necessary for both.

Another alternative is pressure measurement, such as is described in US 5.559.504, US 5.503.029 and US 4.394.773. This, however, has the disadvantage that the sensor surface becomes sensitive to mechanical wear and damage, as the sensor has to have an at least partially compliant surface.

Temperature sensors have also been suggested, for example in US patent 4,429,413 and international patent application PCT/NO96/00082.

Since fingerprint sensors may be exposed to long term use in varying and sometimes demanding conditions the sensor needs to have a robust surface and to be as insensitive to pollution in the fingerprint and on the sensor as possible. It must be capable of reading most fingerprints without being disturbed by latent prints from earlier use. In some cases, e.g. in credit cards or computer keyboards, it would also be advantageous if the sensor could be made compact.

In the view of costs there is also a demand for simplicity and minimizing of the number of parts.

It is an object of the present invention to provide a sensor being easy to produce, making them cheap in production, and also relatively small.

In addition to the solutions mentioned above the measuring of capacitance has been tried as a method to measure finger prints. Examples are shown in US 4.353.056 and US 5.325.442. While the ridges of the fingerprint touches the sensor surface the valleys have a small distance to the sensor surface, resulting in a difference in capacitance and/or conduction measured at the different sensors. Humidity may affect the measurements, but if it is even throughout the fingerprint an analysis of the contrast between the measurements can provide a picture of it.

All the solutions mentioned above are based upon two-dimensional sensor arrays with dimensions comparable to the size of the fingerprint. These are expensive and difficult to produce, since they comprise a large number of sensors simultaneously measuring the surface.

EP 735.502 describes the use of a one or two-dimensional array of sensors being moved in relation to the finger print. The described solution is based on the measuring of resistance, and has a limited resolution defined by the minimum sensor dimensions and the distance between the sensors.

The present invention provides a method and an apparatus for the measuring of structures in a fingerprint or the like, for example using one of the techniques described above, characterized as stated in the disclosed claims 1 and 6.

As the surface of the sensor array is small, and contains few sensors compared to the known solutions, it is inexpensive and relatively simple to make. As the fingerprint to be measured is moved past the sensor array there is no latent fingerprint remaining from the previous user, giving another advantage in relation to the known finger print sensors.

Since the details in the fingerprints are small, it is also difficult to make the sensors of the detector small enough. In a preferred embodiment the apparatus and method according to the invention comprises two or more parallel

lines of measuring points, each line of measuring points being shifted in the longitudinal direction with a distance less than the distance between the measuring points, the sensor array comprising two or more parallel lines of equally spaced sensors, preferably shifted in the longitudinal direction of the sensor array. This provides a possibility to measure structures in the fingerprint smaller than the spacing of the sensors. This is not possible with any of the previously known detector systems.

Thus, it is to be understood that the term "essentially one-dimensional array" here refers to an array having a length being much larger than its width, and may comprise more than one line of sensors.

The invention will be described below with reference to the enclosed drawings, which illustrate one possible embodiment of the invention.

Figures 1a and 1b shows a schematic view of two versions of the sensor.

Figure 2a illustrates the sensor in figure 1b in use, as seen from above.

Figure 2b shows a cross section of the situation in figure 2a.

Figure 3 shows a schematic view of an apparatus according to the invention.

Figure 4 shows a cross section of an embodiment of the invention.

Figure 5 shows a preferred embodiment of the invention.

In figure 1a a single, linear array of sensors 1 is shown. The sensors may be of different kinds, such as pressure sensors or temperature sensors, but preferably they are electrical conductors providing a possibility to measure conduction, impedance or capacitance of the different parts of the fingerprint. The surface to be measured is moved in a perpendicular direction relative to the line of sensors.

In the preferred embodiment the sensors 1 are electrical conductors separated by an insulating material 3 such as epoxy. In the shown embodiment an electrically conducting material 2 surrounds the sensors which may be used to provide a reference potential. Thus the conduction, impedance or capacitance, through the fingerprint, between

each of the sensors 1 and the surrounding reference level may be measured.

The shown embodiment having equally distanced sensors is preferred, but other solutions, e.g. comprising groups of sensors for measuring certain parts of the finger print, is also possible.

Using one or more sensors positioned at one or more chosen distances from the sensor line will provide a possibility for measuring the velocity of the finger print in relation to the sensor by comparing the signals from the sensor line and the time lapse or spacial shift between the measurements of corresponding structures in the surface. Figure 1b shows a preferred embodiment of the invention in which the sensor array comprises two lines of sensors 1.

To be able to measure the structures in a fingerprint the array will typically be 10-15 mm long with a resolution of 50 μm. This is difficult or expensive to obtain using a single line of sensors. In figure 1b the lines are slightly shifted in relation to each other. When moving a surface across the sensor array the measurements of each of the sensors in the second line will fall between the measured point of the first line, providing the required resolution with a larger distance between the sensors. Three or more lines are possible to improve the resolution even more, but more than five would be impractical because of the distance between the lines and the resulting time lapse between the measurements of the first and the last line. Also, an apparatus using many lines would be sensitive to the direction in which the finger is moved.

Although the lines shown in the drawings comprise equally spaced sensors the shifted, second, third etc. lines may comprise single or groups of sensors, increasing the resolution in certain parts of the finger print, and/or measuring differences in velocity of different parts of the finger print, in case the movements is uneven. Also, the second, third etc. lines may have an angle in relation to the first line of sensors.

When using a sensor array comprising two or more sensor lines, as shown in figure 1b, the measurements of the different lines must be combined to provide a signal corre-

sponding to one single line of sensors. To do this the signals from the sensors must be adjusted for the time delay between the signals from the sensors in different lines, and thus the movement of the finger in relation to the sensor array must be known, either by moving the finger or sensor array with a chosen speed, or by measuring the movement of the finger.

Figure 2a illustrates how the finger 4 is moved over a sensor array in the direction perpendicular to the array. In order to obtain exact measurements the movement of the finger must be measured. In addition to the abovementioned method comprising the correlation of measurements from different sensors this may be done in many ways, such as providing a rotating cylinder in contact with the finger, so that the rotation of the cylinder may be measured. Another example may be the use of a thin disk on which the finger may be positioned, which is moved together with the finger and is connected to the apparatus so that the velocity of the disk may be measured. Preferably, however, the movement is measured by correlating or comparing the signals from the different sensor lines, and the time lapse or spacial shift between the measurements of corresponding structures in the surface is found. This way more detailed images can be made from the separate images of each line of sensors.

Another method for adjusting for the movement of the finger is to maintain the sampling rate at the sensor array, while adjusting the number of measured lines used in generating the segmented image of the surface, and thus the interval of the measurements according to movement in order to obtain at least one measurement of each portion of the surface. For example, if the fingerprint is moved slowly over the sensor, while the sampling or measuring frequency is high, the redundant data may simply be neglected and the image of the finger print is comprised by each second or third set of data.

Figure 2b shows a cross section of the finger 4 placed on the sensors 1, and also shows an exaggerated view of the ridges 5 and valleys 6 in the fingerprint.

Figure 3 shows a simplified view of the apparatus according to the invention comprising conductors 7 from the

sensors 1 to an amplifier and multiplexer 8. The signal is then digitized in an A/D-converter 9 before the digital signal is sent to a computer 10 comprising any available computer program being able to analyse the signal.

A cross section of a more realistic embodiment is shown in figure 4, in which one end of closely spaced conductors 11 represent the sensors, and the other end of these conductors are connected to a microchip. The conductors 11 may be a part of a multi layer printed circuit board moulded in epoxy, producing two or more lines of sensors. Each sensor 1 would be about 35×50μm. If the sensors in each line is mounted with distance between the centres of 150μm, the resolution with three shifted lines will be 50μm.

Figure 5 shows an embodiment of the invention where an external time varying, e.g. oscillating or pulsating, voltage 12 is applied to the finger through the conducting area 14 on the side of the sensor area. Planes at a constant voltage 13 are placed close to and parallel to the conductors 11. This reduces cross-talk and noise from external sources, and improves contrast in the image generated from the measurements. This may be implemented by using a multilayer printed circuit board, where one or more of the conducting layers are at a constant voltage. An insulating layer (not shown) preferably covers the conductors 1,11 and shielding planes 13. The conducting area 14 may also be covered by an insulating layer, but this would decrease the signal strength. For better performance, the oscillating voltage 12 may be applied to both sides of the sensor surface. The oscillating voltage may, as mentioned above, be a pulse train, or a sinus.

In one embodiment, a sinus of 100kHz is applied to the conducting area 14, and each of the conductors 11 is terminated by a resistance, and the signal is amplified and feed to a demodulator, multiplexer and analogue-to-digital converter. One advantage of this embodiment is that there are essentially no signal on the conductors 11 in the sensor area when no finger is present, thus reducing problems with offset voltages varying with time and drift in the electronics.

This solution provides a sensor apparatus being simple

to produce using standard techniques, and thus cheap. It is also compact and rugged. If the measured parameter is the resistance the sensors, being the ends of the conductors, will not change their characteristics as they and the surrounding epoxy are worn down. If the capacitance is to be measured a durable, insulating layer is provided on the sensors or conductor ends.

The preferred layout of the sensor also allows the resolution to be better than the distance between the sensors, reducing cross-talk between the sensors.

The method and apparatus according to the invention may of course be utilized in many different ways, and different characteristics may be measured in order to provide a representation of the measured surface, in addition to capacitance and/or conductivity. Optical detectors may be used, and preferably transmitters, so that the reflected image of the fingerprint may be analysed regarding for example contrast and/or colour.

The sensors may, as mentioned above simply be the ends of conductors connected to means for measuring capacitance and/or conductivity, or may be sensors made from semi-conducting materials. A preferred semiconducting material when cost is essential would be silicon.

In the embodiment comprising capacitance measurements an insulating layer (not shown) is provided between the conductor ends and the finger print.

Another possible embodiment within the scope of this invention comprises sensor lines of not equally spaced sensors positioned to measure chosen parts of the fingerprint.

C l a i m s

1. Method for the measuring of structures in a fingerprint or the like, comprising the measuring of chosen characteristics of the surface of the fingerprint, e.g. by measuring capacitance or resistivity, using a sensor array comprising a plurality of sensors, being positioned in contact with, or close to, a portion of the surface, c h a r a c t e r i z e d in the measuring of said characteristics in at least one line of measuring points along an elongated portion of the surface at given intervals of time, the sensor array being an essentially one-dimensional array,

measuring said characteristics using at least one measuring point being positioned at a chosen distance from said line of measuring points in a direction perpendicular to the axis of the line,

moving the surface in relation to the sensor array in a direction perpendicular to the sensor array, so that the measurements are performed at different, or partially overlapping, portions of the surface, and, from said measurements at said line of sensors and said at least one sensor, calculating said movement,

combining the measurements of the measured portions of the surface to provide a segmented, two-dimensional representation of said characteristics of the surface.

2. Method according to claim 1, c h a r a c t e r i z e d in that the measuring points of the array are essentially equally spaced along said essentially one-dimensional array.

3. Method according to claim 1 or 2, c h a r a c t e r i z e d in the measuring of the relative movement of the surface and adjusting the interval of the measurements according to movement in order to obtain at least one measurement of each portion of the surface.

4. Method according to claim 1, 2, or 3, c h a r a c t e r i z e d in that each measurement of the characteristics of an elongated portion of the surface comprises essentially simultaneous measuring of said characteristics along at least two lines of measuring points, one of which comprising said at least one measuring point,

each line of measuring points being shifted in the longitudinal direction with a distance not equal to the distance between the measuring points, the sensor array comprising two or more essentially parallel lines of essentially equally spaced sensors, preferably shifted in the longitudinal direction of the sensor array.

5. Method according to one of the preceding claims, c h a r a c t e r i z e d in that the movement is measured by correlating the measurements from different measuring lines in order to find the time lapse or spatial shift between the similar structures at different lines of measuring points.

6. Apparatus for measuring structures in a fingerprint or the like, comprising a sensor array adapted to be positioned close to, or in contact with, the surface of the fingerprint, the sensor array being adapted to measure chosen characteristics of the surface, e.g. by measuring capacitance or resistivity, at a plurality of positions, c h a r a c t e r i z e d in that the sensor array is an essentially one-dimensional array comprising at least one line of sensors, adapted to measure said characteristics at chosen intervals of time, the surface having a relative movement in relation to the sensor array, with a direction essentially perpendicular to the array,

that the apparatus comprises at least one sensor being positioned at a chosen distance from said line of sensors in a direction perpendicular to said line,

and that the apparatus comprises means for combining the measurements at the different time intervals to obtain a segmented, two-dimensional representation of the characteristics of the surface.

7. Apparatus according to claim 6,
c h a r a c t e r i z e d in that the essentially one-dimensional sensor array comprises two or more parallel lines of essentially equally spaced sensors, said at least one sensor being comprised in said array.

8. Apparatus according to claim 7,
c h a r a c t e r i z e d that said sensor lines are shifted in the longitudinal direction of the sensor array with a distance not equal to the distance between the sensors.

9. Apparatus according to claim 6, 7 or 8,
c h a r a c t e r i z e d in that the apparatus comprises a device for finding the movement of the surface in relation to the sensor array.

10. Apparatus according to claim 9,
c h a r a c t e r i z e d in that the device comprises means for comparing the signals from the different lines of sensors to find the time lapse or spacial shift between the similar structures at the different sensor lines.

11. Apparatus according to any one of claims 7-10,
c h a r a c t e r i z e d in that the sensors are capacitive sensors adapted to measure variations in the capacitance along the sensor array.

12. Apparatus according to claim 11,
c h a r a c t e r i z e d in that voltage supply means for applying a voltage varying with time to the surface to be measured are placed separate from the sensor array, and that a thin insulator separates the conductors in the sensor array from the surface to be measured, the sensors essentially measuring the capacitive coupling through the insulating layer, between the surface to be measured and the conductors.

13. Apparatus according to claim 12, c h a r a c t e r i z e d in that the conductors in the sensor array are placed essentially normal to the surface to be measured, and that one or more planes of constant voltage are placed close to and parallel to the conductors, extending essentially to the insulating layer.

14. Apparatus according to any one of claims 7-13, c h a r a c t e r i z e d in that the sensors comprise electrodes being capable of measuring variations in the electric resistance along the sensor array.

15. Apparatus according to any one of claims 7-10, c h a r a c t e r i z e d in that the sensors comprise optical detectors, and preferably optical transmitters.

16. Apparatus according to any one of claims 7-15, c h a r a c t e r i z e d in that the sensor array is made from a semiconducting material, preferably silicon.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference INT98077D	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/NO98/00182	International filing date *(day/month/year)* 12.06.1998	Priority date *(day/month/year)* 16.06.1997
International Patent Classification (IPC) or national classification and IPC6 G06K 9/00, A61B 5/117		
Applicant SINTEF et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV. ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21.12.1998	03.11.1999
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88 Telex 17978 PATOREG-S	Authorized officer Patrik Blidefalk Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/NO98/00182

I Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

☐ the international application as originally filed.

☒ the description, pages _____, as originally filed,
pages _____, filed with the demand,
pages 1-7, filed with the letter of 1998-07-08,
pages _____, filed with the letter of _____.

☒ the claims, Nos. _____, as originally filed,
Nos. _____, as amended under Article 19,
Nos. _____, filed with the demand,
Nos. 1-14, filed with the letter of 1999-09-24,
Nos. _____, filed with the letter of _____.

☒ the drawings, ~~sheets~~/fig _____, as originally filed,
~~sheets~~/fig _____, filed with the demand
~~sheets~~/fig 1-5, filed with the letter of 1998-07-08,
~~sheets~~/fig _____, filed with the letter of _____.

2. The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, ~~sheets~~/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-14	YES
	Claims		NO
Inventive step (IS)	Claims	1-14	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-14	YES
	Claims		NO

2. Citations and explanations

The claimed invention relates a method and an apparatus for measuring structures in a fingerprint. An essentially one-dimensional sensor array is used to measure capacitance or resistance. The finger is moved in a direction perpendicular to the sensor array and the measured portions are combined to obtain a two-dimensional representation.

Previously known fingerprint sensors are often based on optical solutions, making them sensitive for e.g. dirt. They need to be cleaned or wiped off. Previously known sensors are often based on a sensor matrix, and needs therefore many more detectors, making them bigger and more expensive to manufacture.

The invented solution consists of an array of detectors, e.g. resistive or capacitive. The fingertip is moved across the array and the speed is measured with an additional detector. This makes a sensor, which is relatively small and cheap to produce.

The prior art consists of the following document:

(D1) EP 0 735 502 A2
(D2) JP 8 154 921, A
(D3) JP 10 003 532, A
(D4) JP 10 222 641, A
(D5) WO 86/06266, A1

D1 describes a fingerprint detector that uses an array of resistive detectors for producing a sample when a fingertip is moved across the sensing array. A second array, parallel with the first, detects the speed of the fingertip. (See column 4, line 13 – line 25, line 38 – line 45, column 8, line 26 – line 50, and figures 1 and 5.)

... / ...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V

The documents D2-D5 describe different constructions of a fingerprint sensor. The sensors are optical and not resistive or capacitive, as in the claimed invention. Therefore they are not relevant, they just define state of the art.

The subject matter of claim 1 differs from what is known from D1 in that an alternating voltage is applied to the surface to be measured. The voltage is applied to reduce cross-talk from external sources and noise. None of the cited documents, D1-D5, or any combination of them describe such a method or an apparatus and there is no teaching in the cited art leading a skilled person to the invention. Therefore, the claimed invention is novel (N) and involves an inventive step (IS).

Thus, the invention according to claims 1-14 is novel (N) and fulfils the requirement of inventive step (IS) and industrial applicability (IA).

C l a i m s

1. Method for the measuring of structures in a fingerprint or the like, comprising the measuring of chosen characteristics of the surface of the fingerprint, e.g. by measuring capacitance or resistivity, using a sensor array comprising a plurality of sensors, being positioned in contact with, or close to, a portion of the surface, c h a r a c t e r i z e d in the measuring of said characteristics in at least one line of measuring points along an elongated portion of the surface at given intervals of time, the sensor array being an essentially one-dimensional array,

measuring said characteristics using at least one measuring point being positioned at a chosen distance from said line of measuring points in a direction perpendicular to the axis of the line,

moving the surface in relation to the sensor array in a direction perpendicular to the sensor array, so that the measurements are performed at different, or partially overlapping, portions of the surface, and, from said measurements at said line of sensors and said at least one sensor, calculating said movement,

combining the measurements of the measured portions of the surface to provide a segmented, two-dimensional representation of said characteristics of the surface.

2. Method according to claim 1, c h a r a c t e r i z e d in that the measuring points of the array are essentially equally spaced along said essentially one-dimensional array.

3. Method according to claim 1 or 2, c h a r a c t e r i z e d in the measuring of the relative movement of the surface and adjusting the interval of the measurements according to movement in order to obtain at least one measurement of each portion of the surface.

4. Method according to claim 1, 2, or 3, c h a r a c t e r i z e d in that each measurement of the characteristics of an elongated portion of the surface comprises essentially simultaneous measuring of said characteristics along at least two lines of measuring points, one of which comprising said at least one measuring point,

each line of measuring points being shifted in the longitudinal direction with a distance not equal to the distance between the measuring points, the sensor array comprising two or more essentially parallel lines of essentially equally spaced sensors, preferably shifted in the longitudinal direction of the sensor array.

5. Method according to one of the preceding claims, c h a r a c t e r i z e d in that the movement is measured by correlating the measurements from different measuring lines in order to find the time lapse or spatial shift between the similar structures at different lines of measuring points.

6. Apparatus for measuring structures in a fingerprint or the like, comprising a sensor array adapted to be positioned close to, or in contact with, the surface of the fingerprint, the sensor array being adapted to measure chosen characteristics of the surface, e.g. by measuring capacitance or resistivity, at a plurality of positions, c h a r a c t e r i z e d in that the sensor array is an essentially one-dimensional array comprising at least one line of sensors, adapted to measure said characteristics at chosen intervals of time, the surface having a relative movement in relation to the sensor array, with a direction essentially perpendicular to the array,

that the apparatus comprises at least one sensor being positioned at a chosen distance from said line of sensors in a direction perpendicular to said line,

and that the apparatus comprises means for combining the measurements at the different time intervals to obtain a segmented, two-dimensional representation of the characteristics of the surface.

7. Apparatus according to claim 6, c h a r a c t e r i z e d in that the essentially one-dimensional sensor array comprises two or more parallel lines of essentially equally spaced sensors, said at least one sensor being comprised in said array.

8. Apparatus according to claim 7, c h a r a c t e r i z e d that said sensor lines are shifted in the longitudinal direction of the sensor array with a distance not equal to the distance between the sensors.

9. Apparatus according to claim 6, 7 or 8, c h a r a c t e r i z e d in that the apparatus comprises a device for finding the movement of the surface in relation to the sensor array.

10. Apparatus according to claim 9, c h a r a c t e r i z e d in that the device comprises means for comparing the signals from the different lines of sensors to find the time lapse or spacial shift between the similar structures at the different sensor lines.

11. Apparatus according to any one of claims 7-10, c h a r a c t e r i z e d in that the sensors are capacitive sensors adapted to measure variations in the capacitance along the sensor array.

12. Apparatus according to claim 11, c h a r a c t e r i z e d in that voltage supply means for applying a voltage varying with time to the surface to be measured are placed separate from the sensor array, and that a thin insulator separates the conductors in the sensor array from the surface to be measured, the sensors essentially measuring the capacitive coupling through the insulating layer, between the surface to be measured and the conductors.

13. Apparatus according to claim 12, c h a r a c t e r i z e d in that the conductors in the sensor array are placed essentially normal to the surface to be measured, and that one or more planes of constant voltage are placed close to and parallel to the conductors, extending essentially to the insulating layer.

14. Apparatus according to any one of claims 7-13, c h a r a c t e r i z e d in that the sensors comprise electrodes being capable of measuring variations in the electric resistance along the sensor array.

15. Apparatus according to any one of claims 7-10, c h a r a c t e r i z e d in that the sensors comprise optical detectors, and preferably optical transmitters.

16. Apparatus according to any one of claims 7-15, c h a r a c t e r i z e d in that the sensor array is made from a semiconducting material, preferably silicon.

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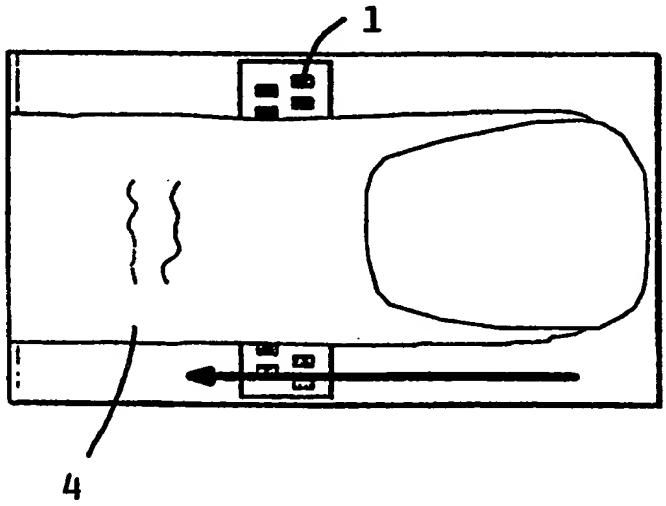
(54) Title: METHOD AND APPARATUS FOR MEASURING STRUCTURES IN A FINGERPRINT

(57) Abstract

Method and apparatus for the measuring of structures in a fingerprint or the like, comprising the measuring of chosen characteristics of the surface of the fingerprint, e.g. by measuring capacitance or resistivity, using a sensor array comprising a plurality of sensors, being positioned in contact with, or close to, a portion of the surface. The characteristics are measured in at least one line of measuring points along an elongated portion of the surface at given intervals of time, the sensor array being an essentially one–dimensional array, moving the surface in relation to the sensor array in a direction perpendicular to the sensor array, so that the measurements are performed at different, or partially overlapping, portions of the surface, combining the measurements of the measured portions of the surface to provide a segmented, two–dimensional representation of said characteristics of the surface.



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PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
INT98077D		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NO98/00182	12.06.1998	16.06.1997
International Patent Classification (IPC) or national classification and IPC_6		
G06K 9/00, A61B 5/117		
Applicant		
SINTEF et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 14 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21.12.1998	03.11.1999
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Telex 17978 PATOREG-S Facsimile No. 08-667 72 88	Authorized officer Patrik Blidefalk /ITW Telephone No. 08-782 25 00

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/NO98/00182

I Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

☐ the international application as originally filed.

☒ the description, pages _____ , as originally filed,
pages _____ , filed with the demand,
pages 1-7 , filed with the letter of 1998-07-08 ,
pages _____ , filed with the letter of _____ .

☒ the claims, Nos. _____ , as originally filed,
Nos. _____ , as amended under Article 19,
Nos. _____ , filed with the demand,
Nos. 1-14 , filed with the letter of 1999-09-24 ,
Nos. _____ , filed with the letter of _____ .

☒ the drawings, ~~sheets~~/fig _____ , as originally filed,
~~sheets~~/fig _____ , filed with the demand
~~sheets~~/fig 1-5 , filed with the letter of 1998-07-08 ,
~~sheets~~/fig _____ , filed with the letter of _____ .

2. The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, ~~sheets~~/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/NO98/00182

V. Resoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-14	YES
	Claims		NO
Inventive step (IS)	Claims	1-14	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-14	YES
	Claims		NO

2. Citations and explanations

The claimed invention relates a method and an apparatus for measuring structures in a fingerprint. An essentially one-dimensional sensor array is used to measure capacitance or resistance. The finger is moved in a direction perpendicular to the sensor array and the measured portions are combined to obtain a two-dimensional representation.

Previously known fingerprint sensors are often based on optical solutions, making them sensitive for e.g. dirt. They need to be cleaned or wiped off. Previously known sensors are often based on a sensor matrix, and needs therefore many more detectors, making them bigger and more expensive to manufacture.

The invented solution consists of an array of detectors, e.g. resistive or capacitive. The fingertip is moved across the array and the speed is measured with an additional detector. This makes a sensor, which is relatively small and cheap to produce.

The prior art consists of the following document:

(D1) EP 0 735 502 A2
(D2) JP 8 154 921, A
(D3) JP 10 003 532, A
(D4) JP 10 222 641, A
(D5) WO 86/06266, A1

D1 describes a fingerprint detector that uses an array of resistive detectors for producing a sample when a fingertip is moved across the sensing array. A second array, parallel with the first, detects the speed of the fingertip. (See column 4, line 13 – line 25, line 38 – line 45, column 8, line 26 – line 50, and figures 1 and 5.)

... / ...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V

The documents D2-D5 describe different constructions of a fingerprint sensor. The sensors are optical and not resistive or capacitive, as in the claimed invention. Therefore they are not relevant, they just define state of the art.

The subject matter of claim 1 differs from what is known from D1 in that an alternating voltage is applied to the surface to be measured. The voltage is applied to reduce cross-talk from external sources and noise. None of the cited documents, D1-D5, or any combination of them describe such a method or an apparatus and there is no teaching in the cited art leading a skilled person to the invention. Therefore, the claimed invention is novel (N) and involves an inventive step (IS).

Thus, the invention according to claims 1-14 is novel (N) and fulfils the requirement of inventive step (IS) and industrial applicability (IA).

METHOD AND APPARATUS FOR MEASURING OF STRUCTURES IN A SURFACE

The invention relates to a method and an apparatus for the measuring of structures in a fingerprint or the like, comprising the measuring of chosen characteristics of the surface of the fingerprint, e.g. capacitance or resistivity, using a sensor array comprising a plurality of sensors, positioned in contact with, or close to, the surface.

Identification by the use of fingerprints has lately come to the fore as a result of the increasing needs for security relating to, for example, credit cards or computer systems as well as the greatly increased availability of pattern recognition algorithms. Some systems for recognition of fingerprints have already been made available on the market. The techniques used to register the fingerprint varies.

Some of the previously known solutions are based upon optical technology using light with one or more wavelengths. These are sensitive to dirt and contamination, both in the fingerprint and on the sensor surface, and thus cleaning is necessary for both.

Another alternative is pressure measurement, such as is described in US 5.559.504, US 5.503.029 and US 4.394.773. This, however, has the disadvantage that the sensor surface becomes sensitive to mechanical wear and damage, as the sensor has to have an at least partially compliant surface.

Temperature sensors have also been suggested, for example in US patent 4,429,413 and international patent application PCT/NO96/00082.

Since fingerprint sensors may be exposed to long term use in varying and sometimes demanding conditions the sensor needs to have a robust surface and to be as insensitive to pollution in the fingerprint and on the sensor as possible. It must be capable of reading most fingerprints without being disturbed by latent prints from earlier use. In some cases, e.g. in credit cards or computer keyboards, it would also be advantageous if the sensor could be made compact.

In the view of costs there is also a demand for simplicity and minimizing of the number of parts.

It is an object of the present invention to provide a sensor being easy to produce, making them cheap in production, and also relatively small.

In addition to the solutions mentioned above the measuring of capacitance has been tried as a method to measure finger prints. Examples are shown in US 4.353.056 and US 5.325.442. While the ridges of the fingerprint touches the sensor surface the valleys have a small distance to the sensor surface, resulting in a difference in capacitance and/or conduction measured at the different sensors. Humidity may affect the measurements, but if it is even throughout the fingerprint an analysis of the contrast between the measurements can provide a picture of it.

All the solutions mentioned above are based upon two-dimensional sensor arrays with dimensions comparable to the size of the fingerprint. These are expensive and difficult to produce, since they comprise a large number of sensors simultaneously measuring the surface.

EP 735.502 describes the use of a one or two-dimensional array of sensors being moved in relation to the finger print. The described solution is based on the measuring of resistance, and has a limited resolution defined by the minimum sensor dimensions and the distance between the sensors.

The present invention provides a method and an apparatus for the measuring of structures in a fingerprint or the like, for example using one of the techniques described above, characterized as stated in the disclosed claims 1 and 6.

As the surface of the sensor array is small, and contains few sensors compared to the known solutions, it is inexpensive and relatively simple to make. As the fingerprint to be measured is moved past the sensor array there is no latent fingerprint remaining from the previous user, giving another advantage in relation to the known finger print sensors.

Since the details in the fingerprints are small, it is also difficult to make the sensors of the detector small enough. In a preferred embodiment the apparatus and method according to the invention comprises two or more parallel

lines of measuring points, each line of measuring points being shifted in the longitudinal direction with a distance less than the distance between the measuring points, the sensor array comprising two or more parallel lines of equally spaced sensors, preferably shifted in the longitudinal direction of the sensor array. This provides a possibility to measure structures in the fingerprint smaller than the spacing of the sensors. This is not possible with any of the previously known detector systems.

Thus, it is to be understood that the term "essentially one-dimensional array" here refers to an array having a length being much larger than its width, and may comprise more than one line of sensors.

The invention will be described below with reference to the enclosed drawings, which illustrate one possible embodiment of the invention.

Figures 1a and 1b shows a schematic view of two versions of the sensor.

Figure 2a illustrates the sensor in figure 1b in use, as seen from above.

Figure 2b shows a cross section of the situation in figure 2a.

Figure 3 shows a schematic view of an apparatus according to the invention.

Figure 4 shows a cross section of an embodiment of the invention.

Figure 5 shows a preferred embodiment of the invention.

In figure 1a a single, linear array of sensors 1 is shown. The sensors may be of different kinds, such as pressure sensors or temperature sensors, but preferably they are electrical conductors providing a possibility to measure conduction, impedance or capacitance of the different parts of the fingerprint. The surface to be measured is moved in a perpendicular direction relative to the line of sensors.

In the preferred embodiment the sensors 1 are electrical conductors separated by an insulating material 3 such as epoxy. In the shown embodiment an electrically conducting material 2 surrounds the sensors which may be used to provide a reference potential. Thus the conduction, impedance or capacitance, through the fingerprint, between

each of the sensors 1 and the surrounding reference level may be measured.

The shown embodiment having equally distanced sensors is preferred, but other solutions, e.g. comprising groups of sensors for measuring certain parts of the finger print, is also possible.

Using one or more sensors positioned at one or more chosen distances from the sensor line will provide a possibility for measuring the velocity of the finger print in relation to the sensor by comparing the signals from the sensor line and the time lapse or spacial shift between the measurements of corresponding structures in the surface. Figure 1b shows a preferred embodiment of the invention in which the sensor array comprises two lines of sensors 1.

To be able to measure the structures in a fingerprint the array will typically be 10-15 mm long with a resolution of 50 μm. This is difficult or expensive to obtain using a single line of sensors. In figure 1b the lines are slightly shifted in relation to each other. When moving a surface across the sensor array the measurements of each of the sensors in the second line will fall between the measured point of the first line, providing the required resolution with a larger distance between the sensors. Three or more lines are possible to improve the resolution even more, but more than five would be impractical because of the distance between the lines and the resulting time lapse between the measurements of the first and the last line. Also, an apparatus using many lines would be sensitive to the direction in which the finger is moved.

Although the lines shown in the drawings comprise equally spaced sensors the shifted, second, third etc. lines may comprise single or groups of sensors, increasing the resolution in certain parts of the finger print, and/or measuring differences in velocity of different parts of the finger print, in case the movements is uneven. Also, the second, third etc. lines may have an angle in relation to the first line of sensors.

When using a sensor array comprising two or more sensor lines, as shown in figure 1b, the measurements of the different lines must be combined to provide a signal corre-

sponding to one single line of sensors. To do this the signals from the sensors must be adjusted for the time delay between the signals from the sensors in different lines, and thus the movement of the finger in relation to the sensor array must be known, either by moving the finger or sensor array with a chosen speed, or by measuring the movement of the finger.

Figure 2a illustrates how the finger 4 is moved over a sensor array in the direction perpendicular to the array. In order to obtain exact measurements the movement of the finger must be measured. In addition to the abovementioned method comprising the correlation of measurements from different sensors this may be done in many ways, such as providing a rotating cylinder in contact with the finger, so that the rotation of the cylinder may be measured. Another example may be the use of a thin disk on which the finger may be positioned, which is moved together with the finger and is connected to the apparatus so that the velocity of the disk may be measured. Preferably, however, the movement is measured by correlating or comparing the signals from the different sensor lines, and the time lapse or spacial shift between the measurements of corresponding structures in the surface is found. This way more detailed images can be made from the separate images of each line of sensors.

Another method for adjusting for the movement of the finger is to maintain the sampling rate at the sensor array, while adjusting the number of measured lines used in generating the segmented image of the surface, and thus the interval of the measurements according to movement in order to obtain at least one measurement of each portion of the surface. For example, if the fingerprint is moved slowly over the sensor, while the sampling or measuring frequency is high, the redundant data may simply be neglected and the image of the finger print is comprised by each second or third set of data.

Figure 2b shows a cross section of the finger 4 placed on the sensors 1, and also shows an exaggerated view of the ridges 5 and valleys 6 in the fingerprint.

Figure 3 shows a simplified view of the apparatus according to the invention comprising conductors 7 from the

sensors 1 to an amplifier and multiplexer 8. The signal is then digitized in an A/D-converter 9 before the digital signal is sent to a computer 10 comprising any available computer program being able to analyse the signal.

A cross section of a more realistic embodiment is shown in figure 4, in which one end of closely spaced conductors 11 represent the sensors, and the other end of these conductors are connected to a microchip. The conductors 11 may be a part of a multi layer printed circuit board moulded in epoxy, producing two or more lines of sensors. Each sensor 1 would be about 35×50μm. If the sensors in each line is mounted with distance between the centres of 150μm, the resolution with three shifted lines will be 50μm.

Figure 5 shows an embodiment of the invention where an external time varying, e.g. oscillating or pulsating, voltage 12 is applied to the finger through the conducting area 14 on the side of the sensor area. Planes at a constant voltage 13 are placed close to and parallel to the conductors 11. This reduces cross-talk and noise from external sources, and improves contrast in the image generated from the measurements. This may be implemented by using a multilayer printed circuit board, where one or more of the conducting layers are at a constant voltage. An insulating layer (not shown) preferably covers the conductors 1,11 and shielding planes 13. The conducting area 14 may also be covered by an insulating layer, but this would decrease the signal strength. For better performance, the oscillating voltage 12 may be applied to both sides of the sensor surface. The oscillating voltage may, as mentioned above, be a pulse train, or a sinus.

In one embodiment, a sinus of 100kHz is applied to the conducting area 14, and each of the conductors 11 is terminated by a resistance, and the signal is amplified and feed to a demodulator, multiplexer and analogue-to-digital converter. One advantage of this embodiment is that there are essentially no signal on the conductors 11 in the sensor area when no finger is present, thus reducing problems with offset voltages varying with time and drift in the electronics.

This solution provides a sensor apparatus being simple

to produce using standard techniques, and thus cheap. It is also compact and rugged. If the measured parameter is the resistance the sensors, being the ends of the conductors, will not change their characteristics as they and the surrounding epoxy are worn down. If the capacitance is to be measured a durable, insulating layer is provided on the sensors or conductor ends.

The preferred layout of the sensor also allows the resolution to be better than the distance between the sensors, reducing cross-talk between the sensors.

The method and apparatus according to the invention may of course be utilized in many different ways, and different characteristics may be measured in order to provide a representation of the measured surface, in addition to capacitance and/or conductivity. Optical detectors may be used, and preferably transmitters, so that the reflected image of the fingerprint may be analysed regarding for example contrast and/or colour.

The sensors may, as mentioned above simply be the ends of conductors connected to means for measuring capacitance and/or conductivity, or may be sensors made from semi-conducting materials. A preferred semiconducting material when cost is essential would be silicon.

In the embodiment comprising capacitance measurements an insulating layer (not shown) is provided between the conductor ends and the finger print.

Another possible embodiment within the scope of this invention comprises sensor lines of not equally spaced sensors positioned to measure chosen parts of the fingerprint.

Amended Claims

1. Method for the measuring of structures in a fingerprint or the like, comprising the measuring of chosen characteristics of the surface of the fingerprint using a sensor array comprising a plurality of sensors, being positioned in contact with, or close to, a portion of the surface,

comprising measuring of said characteristics in at least one line of measuring points along an elongated portion of the surface at given intervals of time, the sensor array being an essentially one-dimensional array,

measuring said characteristics using at least one measuring point being positioned at a chosen distance from said line of measuring points in a direction perpendicular to the axis of the line,

moving the surface in relation to the sensor array in a direction perpendicular to the sensor array, so that the measurements are performed at different, or partially overlapping, portions of the surface, and, from said measurements at said line of sensors and said at least one sensor, calculating said movement,

combining the measurements of the measured portions of the surface to provide a segmented, two-dimensional representation of said characteristics of the surface.

c h a r a c t e r i z e d in that the sensors are capacitive sensors separated from the surface with an insulating film said sensors being adapted to measure variations in the capacitance along the sensor array, and that a varying voltage is applied to the surface to be measured using an electrode being placed separate from the sensor array.

2. Method according to claim 1,

c h a r a c t e r i z e d in that the measuring points of the array are essentially equally spaced along said essentially one-dimensional array.

3. Method according to claim 1 or 2, c h a r a c t e r i z e d in the measuring of the relative movement of the surface and adjusting the interval of the measurements according to movement in order to obtain at least one measurement of each portion of the surface.

4. Method according to claim 1, 2, or 3, c h a r a c t e r i z e d in that each measurement of the characteristics of an elongated portion of the surface comprises essentially simultaneous measuring of said characteristics along at least two lines of measuring points, one of which comprising said at least one measuring point,

each line of measuring points being shifted in the longitudinal direction with a distance not equal to the distance between the measuring points, the sensor array comprising two or more essentially parallel lines of essentially equally spaced sensors, preferably shifted in the longitudinal direction of the sensor array.

5. Method according to one of the preceding claims, c h a r a c t e r i z e d in that the movement is measured by correlating the measurements from different measuring lines in order to find the time lapse or spatial shift between the similar structures at different lines of measuring points.

6. Apparatus for measuring structures in a fingerprint or the like, comprising a sensor array adapted to be positioned close to, or in contact with, the surface of the fingerprint, the sensor array being adapted to measure chosen characteristics of the surface, e.g. by measuring capacitance or resistivity, at a plurality of positions,

the sensor array being an essentially one-dimensional array comprising at least one line of sensors, adapted to measure said characteristics at chosen intervals of time, the surface having a relative movement in relation to the sensor array, with a direction essentially perpendicular to the array,

and the apparatus comprises at least one sensor being

positioned at a chosen distance from said line of sensors in a direction perpendicular to said line,

and the apparatus comprising means for combining the measurements at the different time intervals to obtain a segmented, two-dimensional representation of the characteristics of the surface.

c h a r a c t e r i z e d in that the sensors are capacitive sensors adapted to measure variations in the capacitance along the sensor array,

and in that voltage supply means for applying a voltage varying with time to the surface to be measured are placed separate from the sensor array, and that a thin insulator separates the conductors in the sensor array from the surface to be measured, the sensors essentially measuring the capacitive coupling through the insulating layer, between the surface to be measured and the conductors.

7. Apparatus according to claim 6,
c h a r a c t e r i z e d in that the essentially one-dimensional sensor array comprises two or more parallel lines of essentially equally spaced sensors, said at least one sensor being comprised in said array.

8. Apparatus according to claim 7,
c h a r a c t e r i z e d that said sensor lines are shifted in the longitudinal direction of the sensor array with a distance not equal to the distance between the sensors.

9. Apparatus according to claim 6, 7 or 8,
c h a r a c t e r i z e d in that the apparatus comprises a device for finding the movement of the surface in relation to the sensor array.

10. Apparatus according to claim 9,
c h a r a c t e r i z e d in that the device comprises means for comparing the signals from the different lines of sensors to find the time lapse or spacial shift between the similar structures at the different sensor lines.

11. Apparatus according to claim 6, c h a r a c t e r i z e d in that the conductors in the sensor array are placed essentially normal to the surface to be measured, and that one or more planes of constant voltage are placed close to and parallel to the conductors, extending essentially to the insulating layer.

12. Apparatus according to any one of claims 6-11, c h a r a c t e r i z e d in that the sensors also comprises electrodes being capable of measuring variations in the electric resistance along the sensor array.

13. Apparatus according to any one of claims 6-12, c h a r a c t e r i z e d in that the sensors also comprises optical detectors, and preferably optical transmitters.

14. Apparatus according to any one of claims 6-13, c h a r a c t e r i z e d in that the sensor array is made from a semiconducting material, preferably silicon.

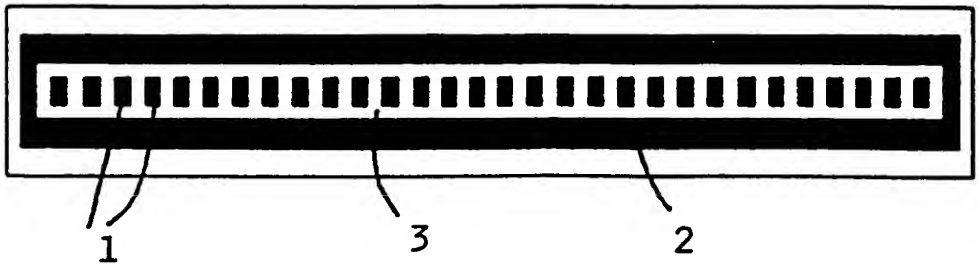

FIG. 1A

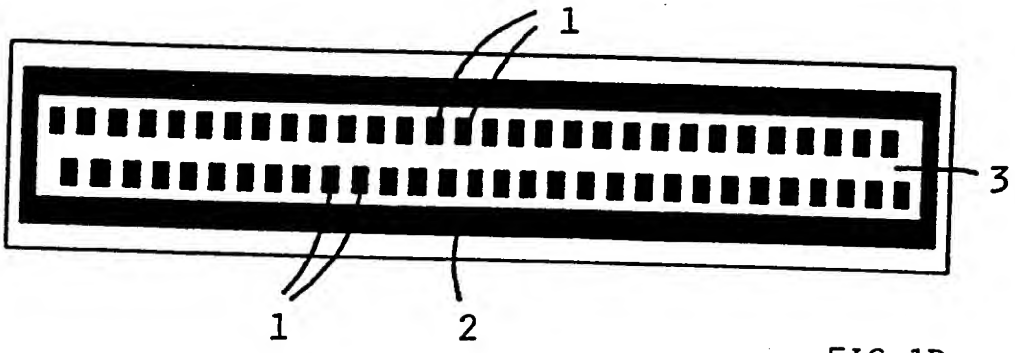

FIG.1B

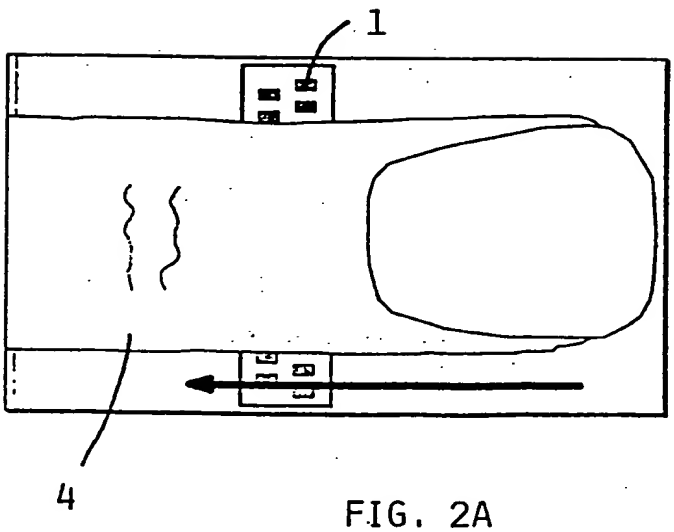

FIG. 2A

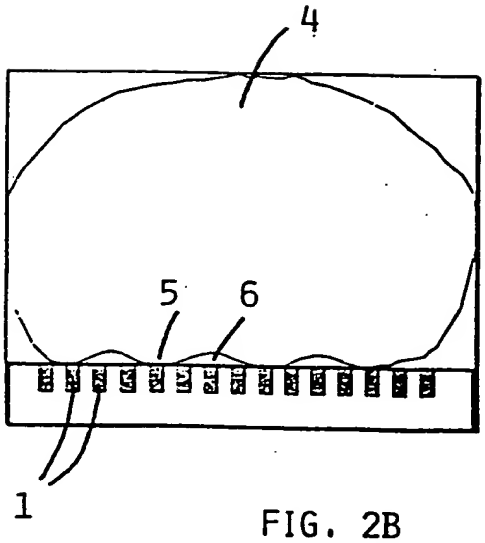

FIG. 2B

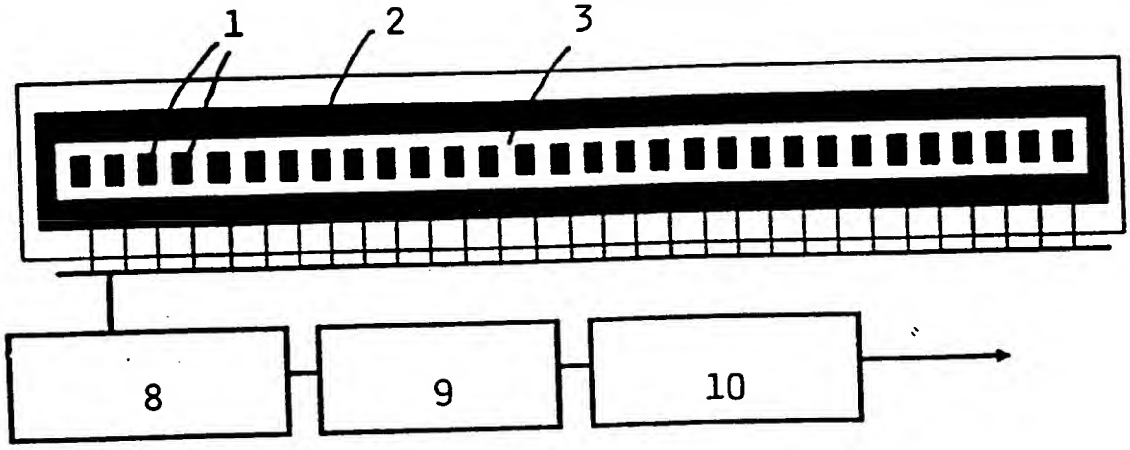

FIG. 3

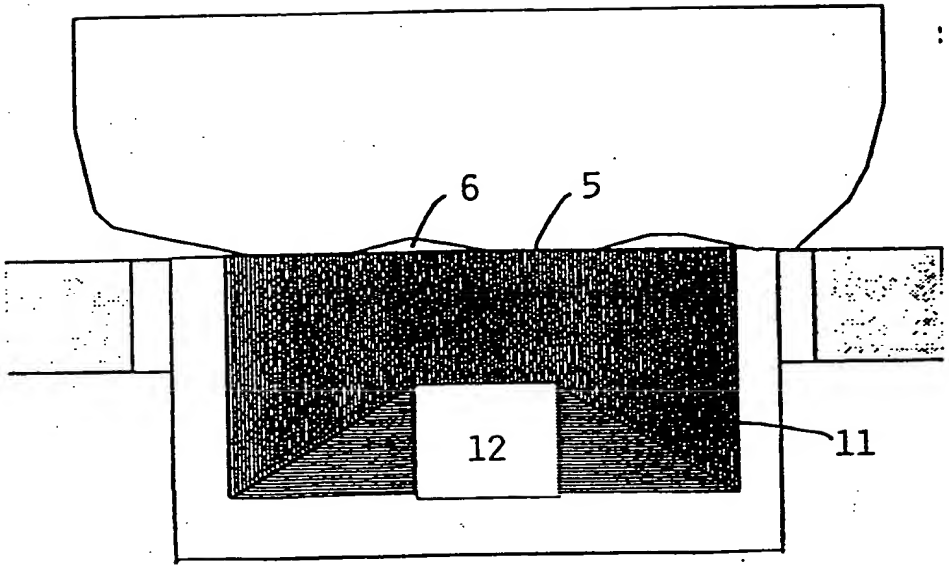

FIG. 4

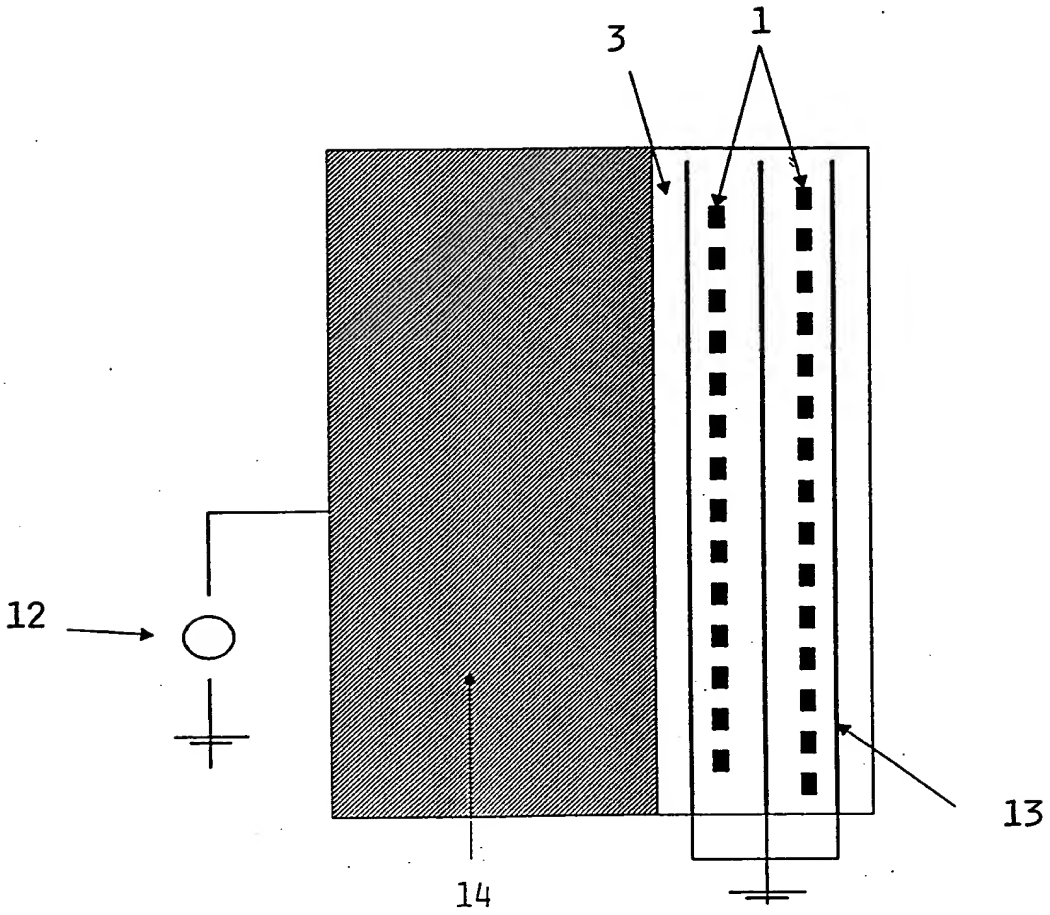

FIG.5